IN THE CLAIMS

Please amend the claims as follows:

1 (Original): An image forming characteristics measuring method in which at least one image forming characteristic of a projection optical system is measured, said method comprising:

a measuring process in which wavefront aberration of said projection optical system is measured at one measurement point at the least in a field of said projection optical system; and

a calculating process in which at least one targeted image forming characteristic is calculated, based on said measuring of wavefront aberration and a Zernike sensitivity table of said targeted image forming characteristic that is prepared in advance.

2 (Original):The image forming characteristics measuring method according to Claim 1 wherein

in said calculating process, when said targeted image forming characteristic include image forming characteristics of a plurality of types, said image forming characteristics of a plurality of types included in said targeted image forming characteristic are each calculated, based on said measuring of wavefront aberration and a Zernike sensitivity table for each of said image forming characteristics of a plurality of types.

3 (Original):The image forming characteristics measuring method according to Claim 1, said method further comprising:

a making process in which conditions are set in order to make a Zernike sensitivity table, based on information on a pattern subject to projection by said projection optical system and said targeted image forming characteristic, and a Zernike sensitivity table of said

targeted image forming characteristic that corresponds to information related to a given aberration is made, based on information related to said projection optical system and information related to said given aberration, prior to said measuring process.

4 (Original):The image forming characteristics measuring method according to Claim 3 wherein

said information related to said projection optical system includes numerical aperture of said projection optical system, illumination condition, and wavelength of illumination light.

5 (Original):The image forming characteristics measuring method according to Claim 3 wherein

in said making process, when said targeted image forming characteristic include image forming characteristics of a plurality of types, a Zernike sensitivity table for each of said image forming characteristics of a plurality of types that correspond to said information related to aberration is made.

6 (Original):The image forming characteristics measuring method according to Claim 1, further comprising:

a displaying process in which information related to said targeted image forming characteristic that has been calculated is displayed.

7 (Original):The image forming characteristics measuring method according to Claim 1 wherein

said Zernike sensitivity table is a table in which a predetermined value of aberration is given to each term in a Zernike polynomial and said targeted image forming characteristic is calculated for a plurality of terms in said Zernike polynomial.

8 (Original): The image forming characteristics measuring method according to Claim 7 wherein

a first information related to a pattern subject to projection by said projection optical system and a second information related to a projection condition of said pattern are used when making said Zernike sensitivity table.

9 (Original):The image forming characteristics measuring method according to Claim 8 wherein

said second information includes numerical aperture of said projection optical system and an illumination condition of said pattern.

10 (Original):The image forming characteristics measuring method according to Claim 7 wherein

when different patterns are each projected by said projection optical system, said targeted image forming characteristic is calculated by making a Zernike sensitivity table for each of said patterns.

11 (Currently Amended): The image forming characteristics measuring method according to Claim 7 wherein

when said targeted image forming characteristic includes [[an]] image forming ~~characteristic~~ characteristics of a plurality of types, the calculation is performed using a

Zernike sensitivity table ~~is made~~ for each of said image forming characteristics ~~to perform said calculation~~.

12 (Currently Amended): The image forming characteristics measuring method according to Claim 7 wherein

when a plurality of projection conditions are settable on projection of a pattern by said projection optical system, said targeted image forming characteristic is calculated using a Zernike sensitivity table ~~is made~~ for each of said projection conditions ~~to calculate said targeted image forming characteristic~~.

13 (Original):An adjusting method of an exposure apparatus that transfers a pattern onto an object via a projection optical system, said method including

a measuring process in which a targeted image forming characteristic of said projection optical system is measured using said image forming characteristics measuring method according to Claim 1.

14 (Original):An image forming characteristics adjusting method in which an image forming characteristic of a projection optical system is adjusted, said method including

a measuring process in which a targeted image forming characteristic is measured using said image forming characteristics measuring method according to Claim 1; and

an adjusting process in which said projection optical system is adjusted based on measurement results of said image forming characteristic.

15 (Original):The image forming characteristics adjusting method according to Claim 14 wherein

said projection optical system comprises a plurality of optical elements that include a specific optical element for adjustment, and

adjustment of said projection optical system is performed by deciding a targeted adjustment amount of said specific optical element using a relation expression between said measured image forming characteristics, parameters that denote a relation between adjustment of said specific optical element and a change in image forming characteristics of said projection optical system, and said targeted adjustment amount of said specific optical element, and adjusting said specific optical element according to said targeted adjustment amount that has been decided.

16 (Original):An exposure method in which a pattern is transferred onto an object via a projection optical system, said method including

an adjusting process in which an image forming characteristic of said projection optical system is adjusted using said image forming characteristics adjusting method according to Claim 14; and

a transferring process in which said pattern is transferred onto said object using said projection optical system whose image forming characteristic is adjusted.

17 (Original):The exposure method according to Claim 16 wherein

said image forming characteristic is adjusted by deciding an adjustment amount of at least one optical element, based on data of a relation between an adjustment amount of an optical element of said projection optical system and a change in its image forming characteristics, and said measured image forming characteristic, and by driving said optical element according to said adjustment amount that has been decided.

18 (Original):An image forming characteristics adjusting method in which an image forming characteristic of a projection optical system is adjusted, said method including:

a measuring process in which a targeted image forming characteristic is obtained using said image forming characteristics measuring method according to Claim 1; and

said image forming characteristic is adjusted by driving an optical element of said projection optical system, based on data of a relation between an adjustment amount of said optical element and a change in coefficients of each term in a Zernike polynomial, and said measured wavefront aberration.

19 (Original):An exposure method in which a pattern is transferred onto an object via a projection optical system, said method including

an adjusting process in which an image forming characteristic of said projection optical system is adjusted using said image forming characteristics adjusting method according to Claim 18; and

a transferring process in which said pattern is transferred onto said object using said projection optical system whose image forming characteristic is adjusted.

20 (Currently Amended): An image forming characteristics adjusting method in which at least one image forming characteristic of a projection optical system comprising a plurality of optical elements that include a specific optical element used for adjustment is adjusted, said method comprising:

an obtaining process in which ~~at least one image forming characteristic~~ wavefront aberration of said projection optical system is obtained, by obtaining information on light via said projection optical system at one measurement point at the least in a field of said

projection optical system, wherein said wavefront aberration is expressed in a Zernike polynomial; and

a deciding process in which a targeted adjustment amount of said specific optical element is decided by computation using a relation expression between said ~~image forming characteristic that has been obtained~~ wavefront aberration, parameters, and a targeted adjustment amount of said specific optical element, said parameters denoting a relation between adjustment of said specific optical element and a change in image forming characteristics of said projection optical system.

21 (Original):The image forming characteristics adjusting method according to Claim 20, said method further comprising:

an obtaining process in which said parameters are obtained, prior to said obtaining process in which said image forming characteristic is obtained.

22 (Original):The image forming characteristics adjusting method according to Claim 20 wherein

in said obtaining process in which said image forming characteristic is obtained, image forming characteristics of a plurality of types are obtained, and

in said deciding process, a target adjustment amount of said specific optical element is decided by computation using a relation expression between said image forming characteristics of a plurality of types that have been obtained, parameters, and a targeted adjustment amount of said specific optical element, said parameters denoting a relation between adjustment of said specific optical element and a change in image forming characteristics of said projection optical system.

23 (Canceled)

24 (Currently Amended): The image forming characteristics adjusting method according to ~~Claim 23~~ Claim 20 wherein

said relation expression is an equation that includes a weighting function that performs weighting on a coefficient of any term in coefficients of each term of said Zernike polynomial.

25 (Original):An exposure method in which a pattern formed on a mask is transferred onto a substrate via a projection optical system, said exposure method comprising:

an adjusting process in which at least one image forming characteristic of said projection optical system is adjusted using said image forming characteristics adjusting method according to Claim 20; and

a transferring process in which said pattern is transferred onto said substrate using said projection optical system whose image forming characteristic is adjusted.

26 (Original):A making method of an exposure apparatus that transfers a pattern of a mask onto a substrate via a projection optical system, said making method comprising:

an adjusting process in which said projection optical system is adjusted using said image forming characteristics adjusting method according to Claim 20.

27 (Original):An exposure apparatus that transfers a pattern formed on a mask onto a substrate via a projection optical system, said exposure apparatus comprising:

a measuring unit that measures wavefront aberration of said projection optical system, said measuring unit being at least partly attachable to an exposure apparatus main body including said projection optical system; and

a first computing unit that calculates at least one targeted image forming characteristic based on wavefront aberration of said projection optical system measured by said measuring unit and a Zernike sensitivity table of said targeted image forming characteristic.

28 (Original):The exposure apparatus according to Claim 27, further comprising:

a storage unit that stores said Zernike sensitivity table in advance.

29 (Original):The exposure apparatus according to Claim 27 wherein

said Zernike sensitivity table is a Zernike sensitivity table of said targeted image forming characteristic that corresponds to information on a given aberration on exposure of a subject pattern.

30 (Currently Amended): The exposure apparatus according to ~~Claim 29~~ Claim 27, further comprising:

an input unit used to input information of various types including information on said subject pattern, information on said targeted image forming characteristic, information related to said projection optical system, and information on said given aberration; and

a second computing unit that set conditions in order to make a Zernike sensitivity table based on said information on said subject pattern and said targeted image forming characteristic input via said input unit, and based on information related to said projection optical system and information related to said given aberration input via said input unit, said second computing unit makes a Zernike sensitivity table of said targeted image forming

characteristic that corresponds to information on said given aberration on exposure of said subject pattern.

31 (Original):The exposure apparatus according to Claim 30 wherein

said information related to said projection optical system includes numerical aperture of said projection optical system, illumination condition, and wavelength of illumination light.

32 (Original):The exposure apparatus according to Claim 27, further comprising:

a display unit which displays information on said targeted image forming characteristic calculated by said first computing unit on screen.

33 (Original):The exposure apparatus according to Claim 27, further comprising:

an image forming characteristics correcting unit that corrects at least one image forming characteristic of said projection optical system based on calculation results of said targeted image forming characteristic by said first computing unit.

34 (Original):The exposure apparatus according to Claim 33 wherein

said projection optical system is structured comprising a plurality of optical elements that include a specific optical element used for adjustment, and

said image forming characteristics correcting unit has a storage unit in which parameters are stored in advance that denotes a relation between adjustment of said specific optical element and a change in image forming characteristics of said projection optical system, and a calculation unit that calculates a targeted adjustment amount of said specific optical element using a relation expression between information on said image forming

characteristic that has been calculated, said parameters, and a targeted adjustment amount of said specific optical element.

35 (Currently Amended): A device manufacturing method including a lithographic process, wherein in said lithographic process, in order to transfer a pattern of a mask onto a substrate using an exposure apparatus having a projection optical system, wavefront aberration of said projection optical system is measured, and a targeted image forming characteristic is calculated based on the measured wavefront aberration and a Zernike sensitivity table of said targeted image forming characteristic ~~exposure is performed using said exposure apparatus according to Claim 27~~.

36 (Original):The exposure apparatus according to Claim 27 wherein

said Zernike sensitivity table is a table in which a predetermined value of aberration is given to each term in a Zernike polynomial and said targeted image forming characteristic is calculated for a plurality of terms in said Zernike polynomial.

37 (Currently Amended): An exposure apparatus that transfers a pattern formed on a mask onto a substrate via a projection optical system, said exposure apparatus comprising:

said projection optical system that comprises a plurality of optical elements including a specific optical element used for adjustment;

a storage unit in which parameters are stored in advance that denotes a relation between adjustment of said specific optical element and a change in image forming characteristics of said projection optical system,

a measuring unit that measures ~~at least one image forming characteristic~~ wavefront aberration of said projection optical system, said measuring unit being at least partly

attachable to an exposure apparatus main body including said projection optical system, wherein said wavefront aberration is expressed in a Zernike polynomial; and

a computing unit that calculates a targeted adjustment amount of said specific optical element using a relation expression between an actual measurement data measured by said measuring unit, said parameters, and a targeted adjustment amount of said specific optical element.

38 (Original):The exposure apparatus according to Claim 37, further comprising:

an image forming characteristics adjusting unit that adjusts at least one image forming characteristic of said projection optical system by adjusting said specific optical element according to said calculated targeted adjustment amount.

39 (Original):The exposure apparatus according to Claim 37 wherein

said measuring unit can measure image forming characteristics of a plurality of types of said projection optical system, and

said computing unit calculates a targeted adjustment amount of said specific optical element using a relation expression between an actual measurement data of said image forming characteristics of a plurality of types measured by said measuring unit, said parameters, and a targeted adjustment amount of said specific optical element.

40 (Canceled)

41 (Currently Amended): The exposure apparatus according to ~~Claim 40~~ Claim 37 wherein said relation expression is an equation that includes a weighting function that

performs weighting on a coefficient of any term in coefficients of each term of said Zernike polynomial.

42 (Currently Amended): A device manufacturing method including a lithographic process, wherein in said lithographic process, in order to transfer a pattern of a mask onto a substrate using an exposure apparatus having a projection optical system, wavefront aberration of said projection optical system is measured, and a targeted adjustment amount of a specific optical element of said projection optical system is calculated, using a relation expression between the measured wavefront aberration, parameters denoting a relation between adjustment of said specific optical element and a change in image forming characteristics of said projection optical system, and the targeted adjustment amount of said specific optical element ~~exposure is performed using said exposure apparatus according to Claim 37~~.

43 (Original):A program that makes a control computer of an exposure apparatus that transfers a pattern of a mask onto a substrate via a projection optical system execute a predetermined process, said program making said control computer execute:

a condition setting procedure in which conditions are set for making a Zernike sensitivity table in response to an input of information related to information on a subject pattern and information on a targeted image forming characteristic; and

a making procedure in which a Zernike sensitivity table of said targeted image forming characteristic corresponding to information on given aberration on exposure of said subject pattern is made, in response to an input of information related to said projection optical system and information on said given aberration.

44 (Original):The program according to Claim 43, said program further making said control computer execute:

a calculating procedure in which said targeted image forming characteristic of said projection optical system is calculated in response to an input of actual measurement data of wavefront aberration of said projection optical system, based on said actual measurement data and said Zernike sensitivity table.

45 (Original):The program according to Claim 44, said program further making said control computer execute:

a displaying procedure in which information on said targeted image forming characteristic that has been calculated is displayed on a display unit.

46 (Original):A program according to Claim 44, said program further making said control computer execute:

an adjusting procedure in which said projection optical system is adjusted so that said targeted image forming characteristic that has been calculated becomes optimal.

47 (Original):A program according to Claim 44, said program further making said control computer execute:

a making procedure in which said Zernike sensitivity table is made in response to input of different information related to said projection optical system and input of information on said given aberration, by each different information related to said projection optical system;

a calculating procedure in which said targeted image forming characteristic of said projection optical system is calculated by each different information related to said projection

optical system in response to input of actual measurement data of wavefront aberration of said projection optical system, based on said actual measurement data and said Zernike sensitivity table; and

a deciding procedure in which an optimum exposure condition is decided by finding information related to said projection optical system that makes said targeted image forming characteristic that has been calculated become optimal.

48 (Original):The program according to Claim 47, said program further making said control computer execute:

a setting procedure in which said optimum exposure condition that has been decided is set.

49 (Currently Amended): An information storage medium that ~~can be~~ is read by a computer in which a program according to Claim 43 is recorded.

50 (Original):A program that makes a control computer execute a process, said program making said control computer execute:

a procedure of calculating a targeted image forming characteristic of a projection optical system in response to an input of information related to said targeted image forming characteristic and an input of actual measurement data of wavefront aberration of said projection optical system, based on said actual measurement data and a Zernike sensitivity table of said targeted image forming characteristic that is prepared in advance.

51 (Original):The program according to Claim 50, said program further making said control computer execute:

a displaying procedure in which information on said targeted image forming characteristic that has been calculated is displayed on a display unit.

52 (Original):The program according to Claim 50, said program further making said control computer execute:

an adjusting procedure in which said projection optical system is adjusted so that said targeted image forming characteristic that has been calculated becomes optimal.

53 (Currently Amended): An information storage medium that ~~can be~~ is read by a computer in which a program according to Claim 50 is recorded.

54 (Currently Amended): A program that makes a control computer of an exposure apparatus that transfers a pattern of a mask onto a substrate via a projection optical system execute a predetermined process, said program making said control computer execute:

a calculating procedure in which a targeted adjustment amount of said projection optical system is calculated in response to an input of actual measurement data of ~~image forming characteristics~~ wavefront aberration of said projection optical system, using a relation expression between ~~said actual measurement data of image forming characteristics that has been input~~ the wavefront aberration expressed in a Zernike polynomial, parameters, and a targeted adjustment amount of said projection optical system, said parameters denoting a relation between adjustment of said projection optical system and a change in image forming characteristics of said projection optical system.

55 (Original):The program according to Claim 54, said program further making said control computer execute:

a displaying procedure in which information on said targeted adjustment amount that has been calculated is displayed on a display unit.

56 (Original):The program according to Claim 54, said program further making said control computer execute:

an adjusting procedure in which said projection optical system is adjusted based on said target adjustment amount that has been calculated.

57 (Original):The program according to Claim 54 wherein

said parameters are parameters denoting a relation between adjustment of a specific optical element used for adjustment that structures said projection optical system and a change in said image forming characteristics, and

said targeted adjustment amount is an amount of said specific optical element that needs to be adjusted.

58 (Canceled)

59 (Currently Amended): The program according to ~~Claim 58~~ Claim 54 wherein said relation expression is an equation that includes a weighting function that performs weighting on a coefficient of any term in coefficients of each term of said Zernike polynomial.

60 (Original):The program according to Claim 54, said program further making said control computer execute:

a condition setting procedure in which conditions are set for making a Zernike sensitivity table in response to an input of information related to information on a subject pattern and an input of information on a targeted image forming characteristic;

a making procedure in which a Zernike sensitivity table of said targeted image forming characteristic corresponding to information on aberration is made, in response to an input of information related to said projection optical system and information on a given aberration; and

a calculating procedure in which said targeted image forming characteristic is calculated in response to an input of actual measurement data of wavefront aberration of said projection optical system, based on said measurement data and said Zernike sensitivity table.

61 (Original):A program according to Claim 60, said program further making said control computer execute:

a displaying procedure in which information on said targeted image forming characteristic that has been calculated is displayed on a display unit.

62 (Original):A program according to Claim 60, said program further making said control computer execute:

a converting procedure in which information obtained on light via said projection optical system at one measurement point at the least in a field of said projection optical system is converted into actual measurement data of said wavefront aberration of said projection optical system.

63 (Currently Amended): An information storage medium that ~~can be~~ is read by a computer in which a program according to Claim 54 is recorded.

64 (Original):An image forming characteristics adjusting method in which at least one image forming characteristic of a projection optical system is adjusted, said method including:

a measuring process in which information related to wavefront aberration of said projection optical system is measured; and

said image forming characteristic is adjusted by driving an optical element of said projection optical system, based on data of a relation between an adjustment amount of said optical element and a change in coefficients of each term in a Zernike polynomial, and said information related to wavefront aberration.

65 (Original):The image forming characteristics adjusting method according to Claim 64 wherein

said information related to wavefront aberration is expressed in a Zernike polynomial, and different weighting is performed on a plurality of terms in said Zernike polynomial to decide said adjustment amount of said optical element, in order to adjust an image forming characteristic of a plurality of types of said projection optical system.

66 (Original):An exposure method in which a pattern formed on a mask is transferred onto an object via a projection optical system, said exposure method comprising:

an adjusting process in which at least one image forming characteristic of said projection optical system is adjusted using said image forming characteristics adjusting method according to Claim 64; and

a transferring process in which said pattern is transferred onto said object using said projection optical system whose image forming characteristic is adjusted.

67 (Original):An exposure method in which a pattern is transferred onto an object via a projection optical system, said method including

a measuring process in which information related to wavefront aberration of said projection optical system is measured;

a calculating process in which a targeted image forming characteristic is calculated for each of a plurality of exposure conditions settable when said pattern is projected by said projection optical system, based on said information related to wavefront aberration and a Zernike sensitivity table that is obtained by giving a predetermined value of aberration to each term in a Zernike polynomial and calculating a targeted image forming characteristic of said projection optical system in each of a plurality of terms in said Zernike polynomial; and

a transferring process in which said pattern is transferred onto said object with an optimum exposure condition set with respect to said pattern, based on said targeted image forming characteristic that has been calculated for each of said exposure conditions.

68 (Original):The exposure method according to Claim 67 wherein

said exposure conditions include numerical aperture of said projection optical system and an illumination condition of said pattern.

69 (Currently Amended): The exposure method according to Claim 67 wherein

said Zernike sensitivity table is ~~made~~ prepared for each of said exposure conditions, and when said targeted image forming characteristic includes [[an]] image forming ~~characteristic~~ characteristics of a plurality of types, the calculation is performed using a Zernike sensitivity table ~~is made and calculated~~ for each of said image forming characteristics.

70 (Currently Amended): The exposure method according to Claim 69 wherein when different patterns are each projected by said projection optical system, by ~~making a Zernike sensitivity table for each of said patterns and~~ calculating said targeted image forming characteristic using a Zernike sensitivity table for each of said patterns, said optimum exposure condition is set for each said different pattern.

71 (Currently Amended): The exposure method according to Claim 67 wherein said Zernike sensitivity table is ~~made~~ prepared for each of said exposure conditions, and when different patterns are each projected by said projection optical system, by ~~making a Zernike sensitivity table for each of said patterns and~~ calculating said targeted image forming characteristic using a Zernike sensitivity table for each of said patterns, said optimum exposure condition is set for each said different pattern.

72 (Original):An exposure method in which a pattern formed on a mask is transferred onto an object via a projection optical system, said exposure method comprising:

an adjusting process in which at least one image forming characteristic of said projection optical system is adjusted using said image forming characteristics adjusting method according to Claim 67; and

a transferring process in which said pattern is transferred onto said object using said projection optical system whose image forming characteristic is adjusted.

73 (Original):An exposure apparatus that transfers a pattern onto an object via a projection optical system, said exposure apparatus comprising:

a computing unit that obtains a targeted image forming characteristic, based on information related to wavefront aberration of said projection optical system and a Zernike

sensitivity table that is obtained by giving a predetermined value of aberration to each term in a Zernike polynomial and calculating said targeted image forming characteristic of said projection optical system in each of a plurality of terms in said Zernike polynomial; and

an adjusting unit that adjusts at least one image forming characteristic of said projection optical system based on one of said information related to wavefront aberration and said targeted image forming characteristic that has been calculated.

74 (Original):The exposure apparatus according to Claim 73 wherein

said Zernike sensitivity table is made using a first information related to a pattern subject to projection by said projection optical system and a second information related to a projection condition of said pattern set when said pattern is projected.

75 (Original):The exposure apparatus according to Claim 74 wherein

said second information includes numerical aperture of said projection optical system and an illumination condition of said pattern.

76 (Currently Amended): The exposure apparatus according to Claim 73 wherein

said computing unit calculates said targeted image forming characteristic using [[a]] the Zernike sensitivity table ~~that is made~~ for each said pattern when different patterns are each projected by said projection optical system.

77 (Currently Amended): The exposure apparatus according to Claim 73 wherein

when said targeted image forming characteristic ~~include~~ includes [[an]] image forming ~~characteristic~~ characteristics of a plurality of types, said computing unit uses [[a]] the

Zernike sensitivity table ~~that is made~~ for each of said image forming characteristics to calculate said targeted image forming characteristic.

78 (Currently Amended): The exposure apparatus according to Claim 73 wherein when a plurality of exposure conditions are settable on projecting said pattern, said computing unit uses [[a]] the Zernike sensitivity table ~~that is made~~ for each of said exposure conditions to calculate said targeted image forming characteristic.

79 (Original):The exposure apparatus according to Claim 73 wherein said adjusting unit adjusts said image forming characteristic by deciding an adjustment amount of at least one optical element, based on data of a relation between an adjustment amount of an optical element of said projection optical system and a change in its image forming characteristics, and said measured image forming characteristic, and by driving said optical element according to said adjustment amount that has been decided.

80 (Original):The exposure apparatus according to Claim 73 wherein said adjusting unit adjusts said image forming characteristic by driving an optical element of said projection optical system, based on data of a relation between an adjustment amount of said optical element and a change in coefficients of each term in a Zernike polynomial, and information related to said wavefront aberration.

81 (Currently Amended): A device manufacturing method including a lithographic process, wherein in said lithographic process, in order to transfer a pattern of a mask onto a substrate using an exposure apparatus having a projection optical system, an image forming characteristic of said projection optical system is adjusted, based on information related to

wavefront aberration of said projection optical system, and a Zernike sensitivity table that is obtained by giving a predetermined value of aberration to each term in a Zernike polynomial and calculating a targeted image forming characteristic of said projection optical system in each of a plurality of terms in said Zernike polynomial ~~exposure is performed using said exposure apparatus according to Claim 73~~.

82 (Original):An exposure apparatus that transfers a pattern onto an object via a projection optical system, said exposure apparatus comprising:

a storage unit that stores data related to a relation between an adjustment amount of an optical element of said projection optical system and a change in coefficients of each term in a Zernike polynomial; and

an adjusting unit that adjusts at least one image forming characteristic of said projection optical system based on information related to wavefront aberration of said projection optical system and said data.

83 (Original):The exposure apparatus according to Claim 82 wherein

said information related to wavefront aberration is expressed in a Zernike polynomial, and said adjusting unit decides said adjustment amount of said optical element by performing different weighting on a plurality of terms in said Zernike polynomial to adjust said image forming characteristic of a plurality of types of said projection optical system.

84 (Currently Amended): A device manufacturing method including a lithographic process, wherein in said lithographic process, in order to transfer a pattern of a mask onto a substrate using an exposure apparatus having a projection optical system, an image forming characteristic of said projection optical system is adjusted, based on data of a relation

between an adjustment amount of an optical element of said projection optical system and a change in coefficients of each term in a Zernike polynomial, and information related to wavefront aberration of said projection optical system ~~exposure is performed using said exposure apparatus according to Claim 82~~.

85 (Original): An exposure apparatus that transfers a pattern onto an object via a projection optical system, said exposure apparatus comprising:

a computing unit that obtains a targeted image forming characteristic when a plurality of exposure conditions are settable on projecting said pattern by said projection optical system, based on information related to wavefront aberration of said projection optical system and a Zernike sensitivity table that is obtained by giving a predetermined value of aberration to each term in a Zernike polynomial and calculating said targeted image forming characteristic of said projection optical system in each of a plurality of terms in said Zernike polynomial; and

an exposure control unit that sets an optimum exposure condition for said pattern, based on said targeted image forming characteristic that has been calculated for each of said exposure conditions.

86 (Original):The exposure apparatus according to Claim 85 wherein

said exposure conditions include numerical aperture of said projection optical system and an illumination condition of said pattern.

87 (Currently Amended): The exposure apparatus according to Claim 85 wherein

said computing unit obtains said targeted image forming characteristic using [[a]] the Zernike sensitivity table [[made]] for each of said exposure conditions, and when said

targeted image forming characteristic includes [[an]] image forming ~~characteristic~~ characteristics of a plurality of types, [[a]] the Zernike sensitivity table ~~that is made for each of said image forming characteristics~~ is also used.

88 (Currently Amended): The exposure apparatus according to Claim 87 wherein

said computing unit calculates said targeted image forming characteristic when different patterns are projected by said projection optical system, using [[a]] the Zernike sensitivity table ~~that is made~~ for each of said patterns, and

said exposure control unit sets an optimum exposure condition for each of said different patterns, based on said targeted image forming characteristic that has been calculated for each of said patterns.

89 (Original):The exposure apparatus according to Claim 85 wherein

said computing unit obtains said targeted image forming characteristic using a Zernike sensitivity table made for each of said exposure conditions, and also when different patterns are each projected by said projection optical system, calculates said targeted image forming characteristic using a Zernike sensitivity table that is made for each of said patterns, and

said exposure control unit sets an optimum exposure condition by said different patterns, based on said targeted image forming characteristic that has been calculated for each of said patterns.

90 (Currently Amended): A device manufacturing method including a lithographic process, wherein in said lithographic process, in order to transfer a pattern of a mask onto a substrate using an exposure apparatus having a projection optical system,

a targeted image forming characteristic of said projection optical system is obtained for each of a plurality of exposure conditions settable when projecting said pattern by said projection optical system, based on information related to wavefront aberration of said projection optical system, and a Zernike sensitivity table that is obtained by giving a predetermined value of aberration to each term in a Zernike polynomial and calculating a targeted image forming characteristic of said projection optical system in each of a plurality of terms in said Zernike polynomial, and

an optimum exposure condition is set with respect to said pattern, based on said targeted image forming characteristic calculated for each of said exposure conditions ~~exposure is performed using said exposure apparatus according to Claim 85~~.

91 (Original):A program that makes a control computer of an exposure apparatus that transfers a pattern of a mask onto an object via a projection optical system execute a predetermined process, said program making said control computer execute:

a measuring procedure in which information related to wavefront aberration of said projection optical system is measured; and

an adjusting procedure in which at least one image forming characteristic is adjusted by driving an optical element of said projection optical system, based on data of a relation between an adjustment amount of said optical element and a change in coefficients of each term in a Zernike polynomial, and information related to said wavefront aberration.

92 (Original):A program that makes a control computer of an exposure apparatus that transfers a pattern of a mask onto an object via a projection optical system execute a predetermined process, said program making said control computer execute:

a measuring procedure in which information related to wavefront aberration of said projection optical system is measured;

a calculating procedure in which a targeted image forming characteristic is calculated in a plurality of exposure conditions settable when projecting said pattern by said projection optical system, based on information related to wavefront aberration of said projection optical system and a Zernike sensitivity table that is obtained by giving a predetermined value of aberration to each term in a Zernike polynomial and calculating said targeted image forming characteristic of said projection optical system in each of a plurality of terms in said Zernike polynomial; and

a transferring procedure in which said pattern is transferred onto said object with an optimum exposure condition set with respect to said pattern, based on said targeted image forming characteristic that has been calculated for each of said exposure conditions.

93 (Original):A program that makes a control computer of an exposure apparatus that transfers a pattern of a mask onto an object via a projection optical system execute a predetermined process, said program making said control computer execute:

an obtaining procedure in which a targeted image forming characteristic is obtained, based on information related to wavefront aberration of said projection optical system and a Zernike sensitivity table that is obtained by giving a predetermined value of aberration to each term in a Zernike polynomial and calculating said targeted image forming characteristic of said projection optical system in each of a plurality of terms in said Zernike polynomial; and

an adjusting procedure in which at least one image forming characteristic of said projection optical system is adjusted, based on said information related to wavefront aberration and said image forming characteristic that has been calculated.

94 (New): The image forming characteristics adjusting method according to Claim 64 wherein

in order to adjust said image forming characteristic, an adjustment amount of said optical element is decided using a Zernike sensitivity table of an image forming characteristic of said projection optical system that becomes an evaluation item.

95 (New): The image forming characteristics adjusting method according to Claim 94 wherein

in order to adjust said image forming characteristic, an adjustment amount of said optical element is decided using the least-squares method.

96 (New): The image forming characteristics adjusting method according to Claim 95 wherein

when different patterns are each projected by said projection optical system, an adjustment amount of said optical element is decided using the Zernike sensitivity table for each of said patterns.

97 (New): The image forming characteristics adjusting method according to Claim 95 wherein

when said image forming characteristic that becomes an evaluation item includes image forming characteristics of a plurality of types, an adjustment amount of said optical element is decided using the Zernike sensitivity table for each of said image forming characteristics of a plurality of types.

98 (New): The image forming characteristics adjusting method according to Claim 95 wherein

when a plurality of projection conditions are settable on projection of a pattern by said projection optical system, an adjustment amount of said optical element is decided using the Zernike sensitivity table for each of said projection conditions.

99 (New): The image forming characteristics adjusting method according to Claim 95 wherein

when a plurality of illumination conditions are settable on projection of a pattern by said projection optical system, an adjustment amount of said optical element is decided using the Zernike sensitivity table for each of said illumination conditions.

100 (New): The image forming characteristics adjusting method according to Claim 64 wherein

information related to wavefront of said projection optical system is measured at each of a plurality of points within a predetermined area, in which a pattern is projected, in a field of said projection optical system, and the measurement information is used for adjustment of said image forming characteristic.

101 (New): The image forming characteristics adjusting method according to Claim 64 wherein

in order to adjust said image forming characteristic, an adjustment amount of said optical element is decided using a weighting function.

102 (New): The image forming characteristics adjusting method according to Claim 101 wherein

for decision of said adjustment amount, the least-squares method is used.

103 (New): The image forming characteristics adjusting method according to Claim 102 wherein

for decision of said adjustment amount, a Zernike sensitivity table is used, said Zernike sensitivity table being obtained by giving a predetermined value of aberration to each term in a Zernike polynomial and calculating an image forming characteristic that becomes an evaluation item of said projection optical system in each of a plurality of terms in said Zernike polynomial.

104 (New): The image forming characteristics adjusting method according to Claim 102 wherein

information related to wavefront of said projection optical system is measured at each of a plurality of points within a predetermined area, in which a pattern is projected, in a field of said projection optical system, and the measurement information is used for decision of said image forming characteristic.

105 (New): An exposure method in which a pattern is transferred onto an object via a projection optical system, said method comprising:

measuring information related to wavefront aberration of said projection optical system;

calculating a targeted image forming characteristic of said projection optical system for each of a plurality of exposure conditions settable when said pattern is projected by said

projection optical system, based on said information related to wavefront aberration and a Zernike sensitivity table relatd to a targeted image forming characteristic of said projection optical system; and

setting an optimum exposure condition with respect to said pattern, based on said targeted image forming characteristic calculated for each of said exposure conditions, and transferring said pattern onto said object.

106 (New): The exposure method according to Claim 105 wherein

said exposure conditions include at least an illumination condition of said pattern.

107 (New): The exposure method according to Claim 106 wherein

said Zernike sensitivity table is decided for each of said exposure conditions, and when said targeted image forming characteristic includes image forming characteristics of a plurality of types, said targeted image forming characteristic is calculated using the Zernike sensitivity table for each of said image forming characteristics of a plurality of types.

108 (New): The exposure method according to Claim 107 wherein

when different patterns are each projected by said projection optical system, said optimum exposure condition is set for each of said different patterns by calculating said targeted image forming characteristic using the Zernike sensitivity table for each of said patterns.

109 (New): The exposure method according to Claim 106 wherein

said Zernike sensitivity table is decided for each of said exposure conditions, and when different patterns are each projected by said projection optical system, said optimum

exposure condition is set for each of said different patterns by calculating said targeted image forming characteristic using the Zernike sensitivity table for each of said patterns.

110 (New): An exposure method in which a pattern is transferred onto an object via a projection optical system, said method comprising:

deciding coefficients of each term in a Zernike polynomial based on information related to wavefront aberration of said projection optical system; and

calculating an image forming characteristic that becomes an evaluation item of said projection optical system, based on said decided coefficients of each term in a Zernike polynomial, and a Zernike sensitivity table that corresponds to a pattern to be transferred onto said object and an illumination condition of the pattern.

111 (New): The exposure method according to Claim 110 wherein

said image forming characteristic that becomes an evaluation item is calculated as a linear sum of said decided coefficients of each term in a Zernike polynomial and said Zernike sensitivity table.

112 (New): The exposure method according to Claim 111 wherein

said Zernike sensitivity table is obtained by giving a predetermined value of aberration to each term in said Zernike polynomial and calculating an image forming characteristic of said projection optical system in each of a plurality of terms in said Zernike polynomial.

113 (New): The exposure method according to Claim 112 wherein

said image forming characteristic that becomes an evaluation item is calculated at each of a plurality of points within a predetermined area, in which a pattern is projected, in a field of said projection optical system.

114 (New): An exposure method in which a pattern is transferred onto an object via a projection optical system, said method comprising:

calculating adjustment information of said projection optical system, based on information related to wavefront aberration of said projection optical system and a Zernike sensitivity table that corresponds to a pattern to be transferred onto said object and an illumination condition of the pattern; and

adjusting said projection optical system based on said calculated adjustment information.

115 (New): The exposure method according to Claim 114 wherein

said adjustment information is calculated by optimizing a weighting function to compensate an error of a pattern image that is projected onto said object.

116 (New): The exposure method according to Claim 115 wherein

for the calculation of said adjustment information, the least-squares method is used.

117 (New): The exposure method according to Claim 116 wherein

an adjustment amount of an optical element of said projection optical system is calculated as said adjustment information, based on data of a relation between the adjustment amount of the optical element of said projection optical system and a change in coefficients of each term in a Zernike polynomial.

118 (New): The exposure method according to Claim 117 wherein

coefficients of each term in a Zernike polynomial are decided by measuring wavefront aberration of said projection optical system, and

for the calculation of said adjustment amount, said decided coefficients of each term in said Zernike polynomial are used.

119 (New): The exposure method according to Claim 118 wherein

said weighting function is a function to perform weighting on said decided coefficients of each term in said Zernike polynomial.

120 (New): The exposure method according to Claim 119 wherein

said adjustment amount is calculated by optimizing said weighting function so that said error does not exceed a permissible value at each of a plurality of points within a predetermined area, in which a pattern is projected, in a field of said projection optical system.

121 (New): The exposure method according to Claim 120 wherein

said Zernike sensitivity table is obtained by giving a predetermined value of aberration to each term in a Zernike polynomial and calculating an image forming characteristic of said projection optical system in each of a plurality of terms in said Zernike polynomial.

122 (New): An exposure apparatus that transfers a pattern onto an object via a projection optical system, said exposure apparatus comprising:

a measuring unit that measures information related to wavefront aberration of said projection optical system, and

a computing unit that decides coefficients of each term in a Zernike polynomial based on said measured information related to wavefront aberration, and calculates an image forming characteristic that becomes an evaluation item of said projection optical system, based on said decided coefficients of each term in a Zernike polynomial and a Zernike sensitivity table that corresponds to a pattern to be transferred onto said object and an illumination condition of the pattern.

123 (New): The exposure apparatus according to Claim 122 wherein

said image forming characteristic that becomes an evaluation item is calculated as a linear sum of said decided coefficients of each term in a Zernike polynomial and said Zernike sensitivity table.

124 (New): The exposure apparatus according to Claim 123 wherein

said Zernike sensitivity table is obtained by giving a predetermined value of aberration to each term in said Zernike polynomial and calculating an image forming characteristic of said projection optical system in each of a plurality of terms in said Zernike polynomial.

125 (New): The exposure apparatus according to Claim 124 wherein

said image forming characteristic that becomes an evaluation item is calculated at each of a plurality of points within a predetermined area, in which a pattern is projected, in a field of said projection optical system.

126 (New): An exposure apparatus that transfers a pattern onto an object via a projection optical system, said apparatus comprising:

a computing unit that calculates adjustment information of said projection optical system, based on information related to wavefront aberration of said projection optical system and a Zernike sensitivity table that corresponds to a pattern to be transferred onto said object and an illumination condition of the pattern; and

an adjusting unit that adjusts said projection optical system based on said calculated adjustment information.

127 (New): The exposure apparatus according to Claim 126 wherein

said adjustment information is calculated by optimizing a weighting function to compensate an error of a pattern image that is projected onto said object.

128 (New): The exposure apparatus according to Claim 127 wherein

for the calculation of said adjustment information, the least-squares method is used.

129 (New): The exposure apparatus according to Claim 128 wherein

an adjustment amount of an optical element of said projection optical system is calculated as said adjustment information, based on data of a relation between the adjustment amount of the optical element of said projection optical system and a change in coefficients of each term in a Zernike polynomial.

130 (New): The exposure apparatus according to Claim 129 wherein

coefficients of each term in a Zernike polynomial are decided by measuring wavefront aberration of said projection optical system, and

for the calculation of said adjustment amount, said decided coefficients of each term in said Zernike polynomial are used.

131 (New): The exposure apparatus according to Claim 130 wherein

said weighting function is a function to perform weighting on said decided coefficients of each term in said Zernike polynomial.

132 (New): The exposure apparatus according to Claim 131 wherein

said adjustment amount is calculated by optimizing said weighting function so that said error does not exceed a permissible value at each of a plurality of points within a predetermined area, in which a pattern is projected, in a field of said projection optical system.

133 (New): The exposure apparatus according to Claim 132 wherein

said Zernike sensitivity table is obtained by giving a predetermined value of aberration to each term in a Zernike polynomial and calculating an image forming characteristic of said projection optical system in each of a plurality of terms in said Zernike polynomial.

134 (New): The exposure apparatus according to Claim 133, further comprising:

a setting unit that is capable of changing an illumination condition of said pattern, wherein

when said illumination condition is changed by said setting unit, said computing unit uses a Zernike sensitivity table corresponding to said changed illumination condition.

135 (New): The exposure apparatus according to Claim 126, further comprising:

a measuring unit that measures wavefront aberration of said projection optical system, said measuring unit being at least partly attachable to an exposure apparatus main body including said projection optical system.

136 (New): An exposure apparatus that transfers a pattern onto an object via a projection optical system, said exposure apparatus comprising:

a computing unit that calculates an image forming characteristic for each of a plurality of exposure conditions, based on information related to wavefront aberration of said projection optical system, and a Zernike sensitivity table corresponding to each of said plurality of exposure conditions that are settable when projecting said pattern by said projection optical system, and

an exposure control unit that sets an optimum exposure condition for said pattern, based on said image forming characteristic calculated for each of said exposure conditions.

137 (New): The exposure apparatus according to Claim 136 wherein

said exposure conditions include at least an illumination condition of said pattern.

138 (New): The exposure apparatus according to Claim 137, further comprising:

a measuring unit that measures wavefront aberration of said projection optical system, said measuring unit being at least partly attachable to an exposure apparatus main body including said projection optical system.

139 (New): A device manufacturing method, wherein

a device pattern is transferred onto a photosensitive object using said exposure method according to Claim 105.

140 (New): A device manufacturing method, wherein

a device pattern is transferred onto a photosensitive object using said exposure method according to Claim 110.

141 (New): A device manufacturing method, wherein

a device pattern is transferred onto a photosensitive object using said exposure method according to Claim 114.

142 (New): A program that makes a control computer of an exposure apparatus that transfers a pattern onto an object via a projection optical system execute a predetermined process, said program making said control computer execute:

a deciding procedure in which coefficients of each terms of a Zernike polynomial are decided based on information related to wavefront aberration of said projection optical system; and

a calculating procedure in which an image forming characteristic that becomes an evaluation item of said projection optical system is calculated, based on said decided coefficients of each term of a Zernike polynomial and a Zernike sensitivity table that corresponds to a pattern to be transferred onto said object and an illumination condition of the pattern.

143 (New): A program that makes a control computer of an exposure apparatus that transfers a pattern onto an object via a projection optical system execute a predetermined process, said program making said control computer execute:

a calculating procedure in which adjustment information of said projection optical system is calculated, based on information related to wavefront aberration of said projection optical system, and a Zernike sensitivity table that corresponds to a pattern to be transferred onto said object and an illumination condition of the pattern; and

an adjusting procedure in which said projection optical system is adjusted based on said calculated adjustment information.

144 (New): A program that makes a control computer of an exposure apparatus that transfers a pattern onto an object via a projection optical system execute a predetermined process, said program making said control computer execute:

a measuring procedure in which information related to wavefront aberration of said projection optical system is measured; and

an adjusting procedure in which an image forming characteristic of said projection optical system is adjusted by driving an optical element of said projection optical system, based on data of a relation between an adjustment amount of said optical element and a change in coefficients of each term in a Zernike polynomial, and said information related to wavefront aberration.

145 (New): A program that makes a control computer of an exposure apparatus that transfers a pattern onto an object via a projection optical system execute a predetermined process, said program making said control computer execute:

a calculation procedure in which an image forming characteristic for each of a plurality of exposure conditions is calculated, based on information related to wavefront aberration of said projection optical system, and a Zernike sensitivity table corresponding to

each of said plurality of exposure conditions that are settable when projecting said pattern by said projection optical system; and

a transferring procedure in which an optimum exposure condition for said pattern is set based on said image forming characteristic calculated for each of said exposure conditions, and said pattern is transferred onto said object.